

3rd Conference of

MEDICAL ARTHROPODOLOGY



Central Theme:

**INTEGRATED DISEASE VECTOR MANAGEMENT:
TRANSLATIONAL RESEARCH**

December 18 - 19, 2009 • Hotel Sangam, Madurai

Dr. M.O.T. IYENGAR

**BIO-BIBLIOGRAPHY OF AN EMINENT
MEDICAL ENTOMOLOGIST**

By :

R. Iyengar* and Tara Gandhi**

*Scientist, Malaria Eradication Programme, World Health Organization (Retd.)

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Organized by

Centre for Research in Medical Entomology

(Indian Council of Medical Research, MOH&FW, Govt. of India)
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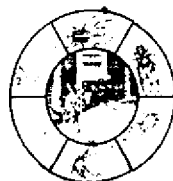




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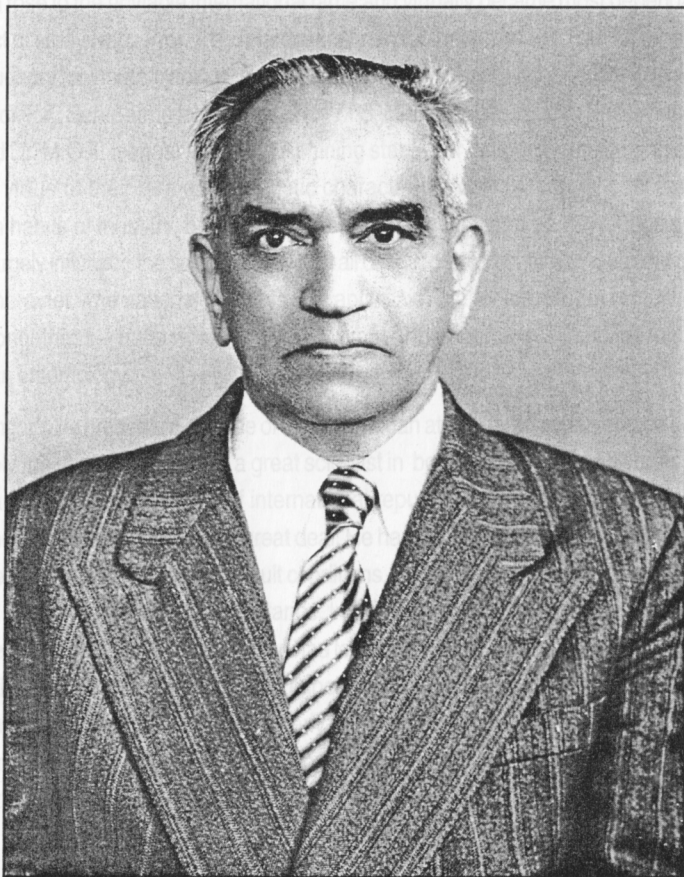


PREFACE

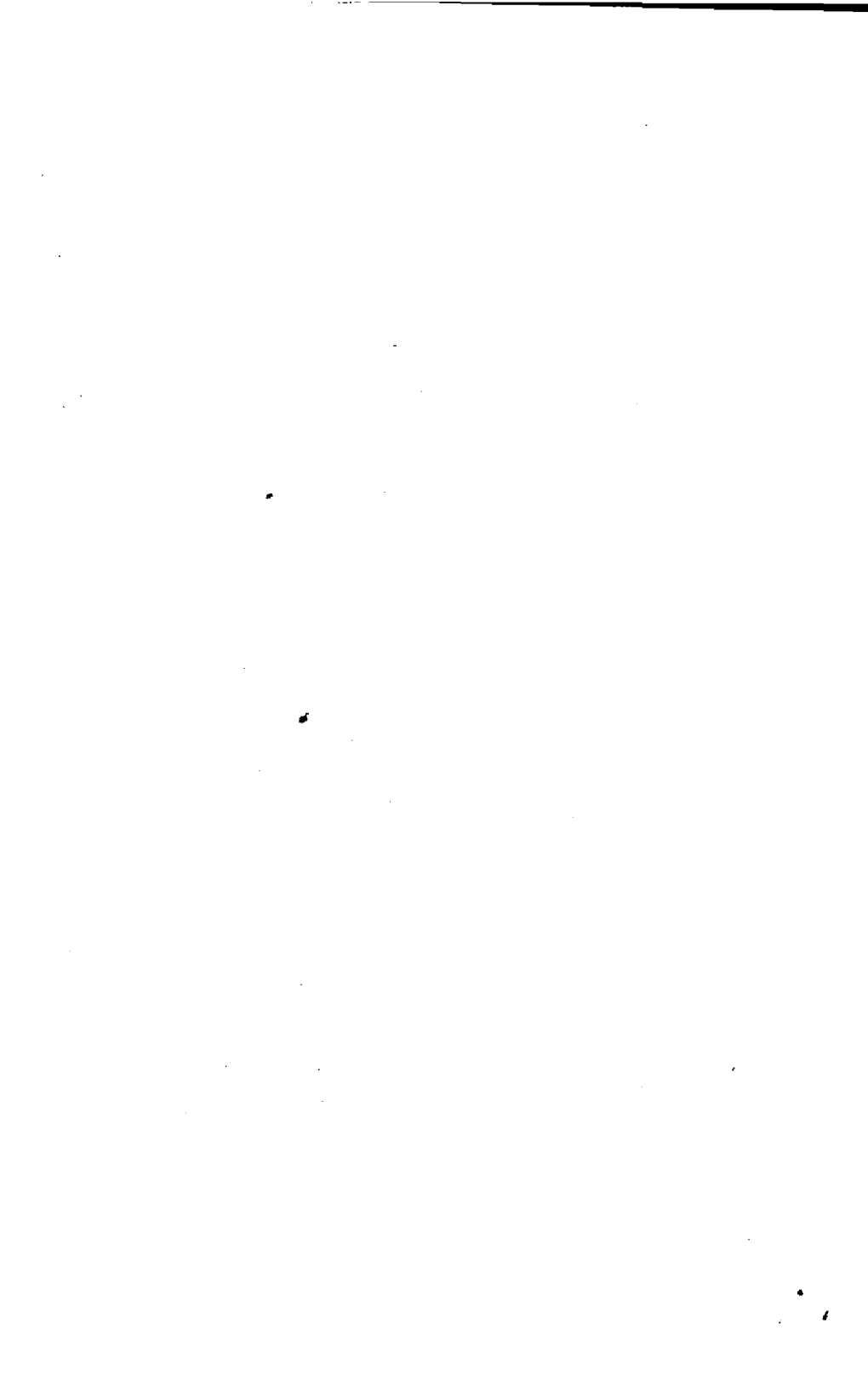
*"Endowed with all other attributes in full
but without a variable ruler."*

Dr. M.O.T. Iyengar

Bio-bibliography of an eminent medical entomologist



(1895 – 1972)



PREFACE

*"Endowed with all other attributes in full,
but without a capable ruler,
a country languishes in peril"*

The kingdom of science, and in present context medical entomology, is seemingly very much a reflection of these famous lines by the famous south Indian poet, Thirukkural; entomological giants have to be there at all times in order to guide future course of growth of this great branch of the wonderful science of Medical Arthropodology. India is blessed with an array of highly luminescent entomologists many of whom rose to the enviable international fame and virtually became most dependable authority on their subject of study (e.g., Prof. T.N. Ananthakrishnan for thrips, Dr. T.R. Rao for mosquitoes, Prof. S.P. Ray-Chaudhury for insect cytology, Prof. G.P. Sharma for insect cytogenetics, Prof. R.N. Roonwal for termites, Prof. P.K. Sen-Sarma for termites, Prof. M.S. Mani for high altitudinal insect fauna etc., just to exemplify) and Dr. M.O.T. Iyengar was such a shining star in our galaxy of outstanding entomologists who by sheer virtue of their rare and energetic character not only practically educate the budding researchers in habits of industry, but by the example of diligence and perseverance which they set before them, largely influence the scientific activity in all directions and contribute in a great degree to form the national character. The national progress, it is aptly said, is after all the sum of individual industry, energy and uprightness – traits which Dr. M.O.T. Iyengar most profoundly exhibited in the glorious annals of Indian entomology.

M.O.T. Iyengar's life presents a glimpse of the rare human attributes of perseverance and application which invariably make an entomologist a great scientist in both the personal and professional life. Dr. M.O.T. Iyengar was an entomologist of international repute and contributed to the development of medico-entomological disciplines a very great deal. He had studied entomology both in laboratory and field, extensively working in far off and difficult conditions – often setting up field laboratory in make-shift arrangements with minimal tools and assistance. His greatest accomplice was his determination and whatever he resolved to achieve in science he had left no stone unturned and kept making efforts till he got the desired results from his long and tiring experimentations! He never left on tomorrow the work of today and would see to it that all data are properly recorded on data-sheets for analysis. Such was the devotion of Dr. M.O.T. Iyengar to medical entomology that even the best of world's entomologists conformed, without an iota of skepticism, to his observations.

Dr. M.O.T. Iyengar had many great virtues but one that can be quoted here for the youngsters to emulate is that he always first accomplished his task, with all information duly obtained through rigorous path of examining and re-examining the datasets, and then would speak of his achievement – a characteristic

that the budding scientists should invariably emulate in their own scientific pursuit. As a principle, all genius men and women of science do not necessarily do extraordinary things right away, but they certainly do things, even the most trivial and insignificant looking matter, in a most extraordinary way. That is what makes them genius, and Dr. M.O.T. Iyengar was such an extraordinary genius entomologist in our own lifetime!

It is believed that this bio-bibliography of Dr. M.O.T. Iyengar, written largely from an entomological perspective in the finest CMA (*Conference of Medical Arthropodology*) tradition, will seed into young minds the habit of perseverance and application, and continue to bear for our great country genius-entomologists like Dr. M.O.T. Iyengar.

18th December, 2009

(Dr. B.K. Tyagi *et al.*, the Editors)

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Foreword

It is not always that one comes across committed scientists with a deep sense of devotion and determination, with an uncanny sense of eagerness to unfold the intricacies of Medical Entomology. Such an incomparable passion and personal discipline enabled one committed entomologist to reveal his personal capabilities in this field, with special reference to vectors of human diseases such as malaria and filariasis. His publications covering the epidemiology of these diseases and his studies on symptomatology, aetiology, pathology, diagnosis and treatment have made Prof. Iyengar immortal. His monumental contribution have stood the test of time and have laid a strong foundation for the subsequent generation of medical entomologists. He is undoubtedly a unique model to be followed by entomologists and his threefold objectives of personal discipline, diligence and perseverance made him a scientist extraordinary whose contributions have been internationally accepted and respected.

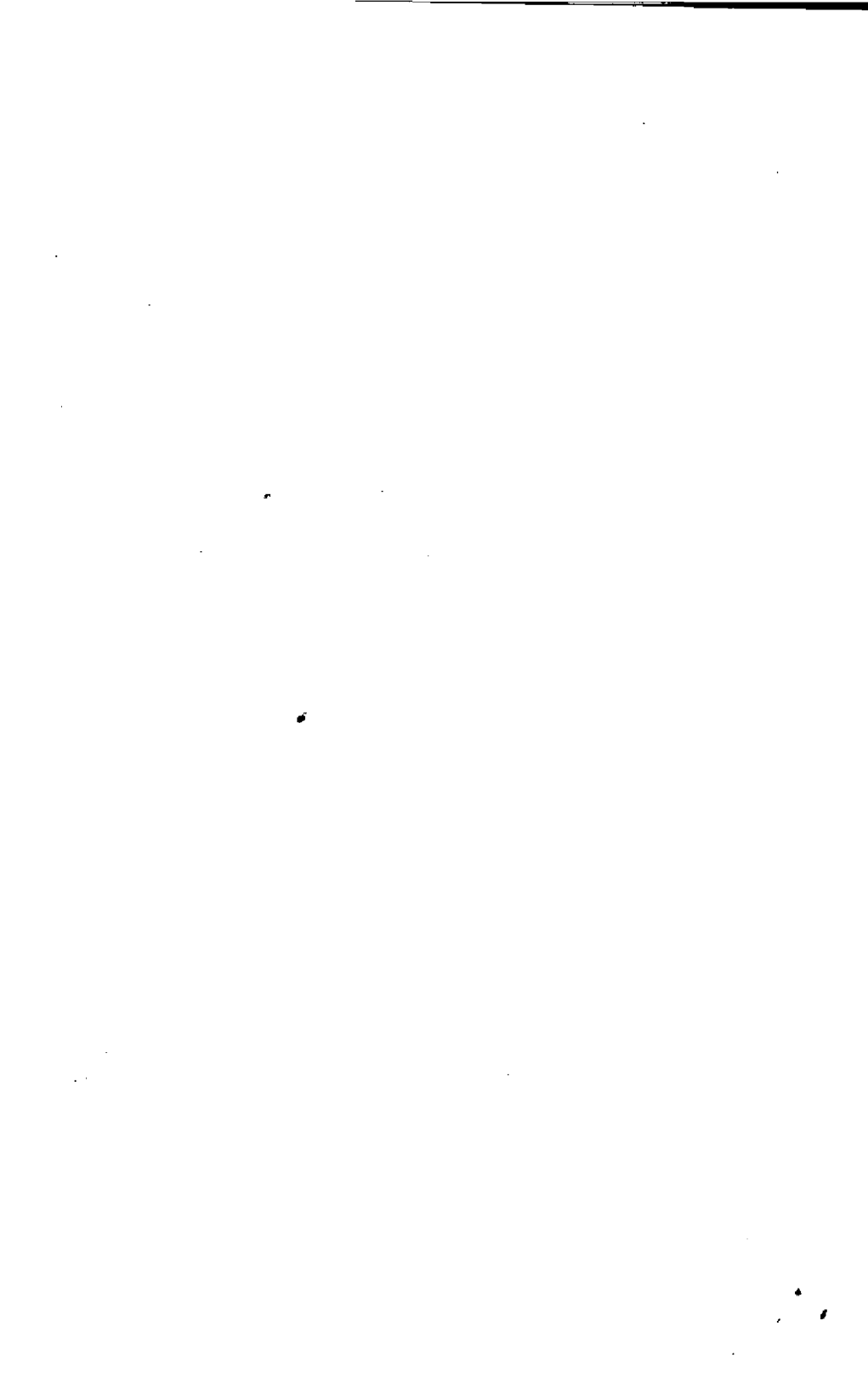
That two brothers, M.O.P. Iyengar an authority on Algae and M.O.T. Iyengar an equally respected medical entomologist could hold the international scene for many years is something unusual, besides kindling the interests of many researcher to emulate their feats.

Personally speaking, I have watched these two great men of science with a feeling that I should also emulate their attainments, when I had just started my career in the fifties of the last century. Needless to say that they inspired many to become experts in their own field, but it is always difficult to fill the void created by them.

I wish to congratulate Dr. R. Iyengar and Tara Gandhi on their efforts to unfold to the scientific community the scientific exploits of Dr. M.O.T. Iyengar which will always stand the test of time, and to the whole CRME editorial team led by Dr. B.K. Tyagi for their unparalleled courage to bring out this beautiful, highly stimulative bio-bibliographic book for an everlasting benefit of the budding scientists, in particular.

Chennai
27-10-2009

T.N. Ananthakrishnan



INTRODUCTION

Dr. M.O.T. Iyengar (affectionately known as "Thinnani" to his close friends and relatives) was born in Madras (now known as Chennai) on 6th February 1895. He came from a very illustrious family. His father was a senior judge in the then Madras Presidency High Court of British India. His elder brother, Professor M.O.P. Iyengar (1886 – 1963), a prominent botanist and physiologist at the Presidency College, University of Madras, who researched different types of algae in relation to their structure, cytology, reproduction and taxonomy of major groups, and, for his excellent research contribution to algal science, was also referred to as the "Father of Algology in India". After his early education at Hindu High School, Triplicane, Madras, and his graduation from Presidency College, Madras, Dr. M.O.T. Iyengar distinguished himself as a medical entomologist. His main interest was the study of mosquitoes, but he was equally interested in other insects of medical importance. These included *infestations of human intestines by corpid beetles, a study of the life history of the tinged bug and the systematics of rat-fleas in India*. He was also a keen botanist. His studies on dimorphism of the flowers of two species of *Monochoria* as an adaptation for cross-pollination by insects is still very favourably regarded by many botanists.

M.O.T. Iyengar began his career as an Entomologist in-Charge of Bengal Malaria Research Laboratory, Calcutta, India (1918-1931 & 1935-1947), but intermittently also took up to the post of the Instructor on Medical Parasitology and Entomology to D.P.H. students (1920-1922), Professor of Medical Entomology, School of Tropical Medicine, Calcutta (1922-1923), and Medical Entomologist to the Government of Travancore under the auspices of the Rockefeller Foundation (1931-1934). Of particular mention is his vocation in Travancore State (now known as Kerala) where he studied the incidence and distribution of filariasis (Fig 1). The results of his studies showed (i) the distribution of *Wuchereria bancrofti* and *W. malayi* infections in this southern state of India, (ii) their endemicity, (iii) factors that determine this endemicity, and (iv) methods for their control. The correlation between the infection rate and the disease rate, and the supposed antagonism between malaria and filarial infections are discussed in his ICMR *Memoir* published in 1938. This publication is still regarded as a text book on filarial epidemiology.



Fig. 1. Map of Travancore showing distribution of *F. malayi* and *W. bancrofti*

At the young age of 33, he was awarded the prestigious Earl of Minto Gold Medal for medical research in India, in 1929. By 1934, his fame as a medical entomologist was well established and he was invited to many universities and research organizations in Europe. During the two years he spent in Europe he was associated with leading entomologists and parasitologists like Prof. P.A. Buxton (of London School of Hygiene and Tropical Medicine), Prof. W. Schuffner and Dr. S.L. Brug (of Institut voor Tropische Hygiene, Amsterdam, Holland), Prof. Emile Brumpt and Dr. Henri Galliard (of Institut de Parasitologie, Faculte de Medecine, Paris), Prof. Swellengrebel (of Institut fur Schiffs-u. tropen-krankheiten, Hamburg, Germany) and Mr. P.G. Shute (of Malaria Reference Laboratory, Horton Hospital, Epsom, England). In 1939 he obtained his Degree of Doctor of Science from the University of Madras.

Dr. M.O.T. Iyengar was with the Government of West Bengal for nearly three decades, initially as Entomologist, Bengal Malaria Research Laboratory, and later as Malaria Officer. After highly celebrated works of Stephens and Christophers in the early 1900s, it was Dr. Iyengar who was responsible for the surveys of malaria in Calcutta and its environs. His papers on the incidence of malaria in deltaic Bengal and methods for the control of the disease and problems related to it, still hold good to this day. He was an ardent advocate of biological control of mosquito larvae. Two fungi of the *Coelomomyces* group described by him have been successfully used in the control of anopheline larvae in India. The fact that one species of a mermithid nematode, *Romanomermis iyengari*, and a culicine mosquito, *Culex iyengari*, have been named in his honour, is a good testament of his huge popularity. *Romanomermis iyengari*, in particular, has been shown to be an effective parasite of mosquito larvae in Brazil.



Dr. M.O.T. Iyengar in his laboratory in Bangalore

During his long and challenging career Dr. M.O.T. Iyengar shouldered several positions of great responsibilities. Between 1941 -1944, he served as Honorary Adviser on malaria control to the US Army, British Land Forces and Royal Air Force in Bengal, and as Malaria Officer to the Government of West Bengal from 1947 to 1950. From 1949 to 1952, he was a Consultant on Filariasis to the World



Left : Dr. Iyengar demonstrating live filarial worms under the microscope to members of the Aitutaki Island Council (part of the Cook Islands).

Right : Dr. Iyengar speaks to members of the Child Welfare Committee in Aitutaki of the filariasis problem in the Cook Islands. Cook Islands Medical Practitioner John Mokotupu acts as interpreter.

Health Organization and had assignments in Ceylon (now Sri Lanka), Maldives Islands, Thailand and Afghanistan. His love and dedication for tropical medicine was unmatched and would never give a second thought whenever such an opportunity came along his way. Therefore, when soon after he was awarded a decoration by the Public Health Services of the Government of Thailand in recognition of his researches on filariasis in Thailand in 1952, he was asked by the South Pacific Commission (SPC), in 1953, if he would accept the position of Research Specialist on Mosquito-borne Diseases, Dr. Iyengar instantly agreed whole-heartedly for his love for research knew no bounds. He also knew that while in the South Pacific he would be associated with some great French epidemiologists like Dr. Guy Loisson, Dr. Emile Massal and Dr. J. Kerrest – a judgement which later proved to be a great boon for Dr. Iyengar in his own scientific pursuits. The South Pacific Commission was founded in 1947 by six countries, viz., Australia, France, The Netherlands, New Zealand, the United Kingdom and the United States of America (Netherlands and the United Kingdom have since withdrawn). It is a regional inter-governmental organization whose membership includes both nations and territories. The Commission's purpose is to advise the participating Governments on ways of improving the wellbeing of the people of the Pacific islands in health, economic and social matters. Altogether twenty-two governments and territories are involved with

approximately five million people scattered over some thirty million square kilometers. Less than two per cent of the region is land. Dr. Iyengar's task was to compile an annotated bibliography on filariasis, elephantiasis and related aspects and circulate to member Governments, territories and others concerned with these problems. This involved the collection of papers, either as reprints, photocopies or micro-films, published in journals or periodicals throughout the world but pertaining to filariasis in the South Pacific Region. That this was achieved by Dr. Iyengar who reviewed all the papers and completed the abstracts will be seen from his publications in Part-I: Epidemiology of filariasis, Part-II: Studies on mosquitoes in the South Pacific Region, Part-III: Symptomatology, aetiology, pathology and diagnosis of filariasis, Part-IV: Treatment of filariasis, and Part-V : Prophylaxis and control of filariasis. Over 2000 published articles by over 1000 authors were reviewed and abstracted in his 7-year stay with SPC - a truly remarkable piece of work! In addition, Dr. Iyengar carried out filariasis surveys in 8 of the 22 territories and recommended to the governments concerned measures for the control of the disease. In these investigations he was ably assisted by his technical assistant, Mr. M.A.U. Menon.

Even after his return to India, Dr. Iyengar continued to write about filariasis in the South Pacific - such was his passion for research! In a paper published in 1965, he writes about the two biological races of *Wuchereria bancrofti*, the periodic and the non-periodic. Each of these two races is further divided into two zones depending on the vectors but no difference in morphology or in pathogenicity was found. The evolution of the Micronesian strain of periodic *W. bancrofti* is also discussed.

Dr. Iyengar was an epitome of devotion, determination and discipline. His sense of promptness and sincerity was superlative. In the early fifties he was asked by the World Health Organization to study and report on the incidence of filariasis in the Maldive Islands. He was accompanied by his two assistants, Dr. M.I. Mathew and Mr. M.A.U. Menon. A 60-ton schooner was placed at their disposal by the ruler of Maldive Islands and it served as their home and laboratory. After completing his investigations in four months, they set sail to return to India. Halfway through, a cyclone hit the schooner. Tossed around for two days, the schooner was swept ashore in the island of Seychelles in East Africa. This near-fatal incident did not deter Dr. Iyengar and after hardly four months elapsed he soon was set on accomplishing another assignment to Thailand for WHO!

Dr. Iyengar was a distinguished member or fellow of several reputed scientific societies. He was a Membre-correspondant, Societe Pathologie Exotique, Paris, Member, W.H.O. Expert Advisory Panel on Malaria, Member, W. H. O. Expert Advisory Panel on Parasitic Diseases, Member, Advisory Committee on Malaria, Indian Research Fund Association, and later of Indian Council of Medical Research, and Member, Advisory Committee on Filariasis, Indian Research Fund Association, and later of Indian Council of Medical Research.

Dr. Iyengar loved teaching and interacting with young scientists. As a teacher and mentor, he guided students through their DPH and DTM&H courses at the Calcutta Medical College and the Calcutta School of Tropical Medicine. As a strict disciplinarian, he observed immaculate execution of all his deeds and undertook assignments meticulously to be always prompt in their accomplishment. His adherence to disciplined life, however, did not restrict only to his professional manoeuvres but he observed discipline at home as well! His son (Dr. R. Iyengar) recalls, "He was a highly disciplined scientist. As parents of six, he and my mother believed firmly in discipline; dinners every evening would be at 8 and all of us should be present and weekends were devoted to spend time with the family exclusively and no visitors or guests were allowed. The guidance and support that he gave us all through our higher education is a memory each one of us will cherish." His grand daughter, Tara Gandhi reminisces, "Ayya (as Dr. M.O.T. Iyengar was fondly and respectfully called by his offspring) was always a very busy scientist. Even though he had retired from the WHO and the South Pacific Commission, he never appeared to be a retired person and actively continued with his own research." She further travels down the memory lane recounting, "As a schoolgirl I would spend my summer vacations with my grandparents and was always fascinated by the informal laboratory Ayya had set up in his house. It was no more than a large wooden table with an old-fashioned black microscope on it, glass slides, test tubes, dissecting instruments and numerous small bottles of preservatives and other liquids that gave the room a peculiar smell. There was also a miniature mosquito net that looked as though it was a doll's bed, but actually it held mosquitoes inside for his experiments. For very long hours through day and night Ayya would be bending over his microscope, intently concentrating on his work. If he noticed me watching him, he would call me and let me look at his slides. Through those lenses I could catch a glimpse of what was his passion. He showed me the mouth parts of a mosquito, its stomach contents he had teased out, drops of blood and many other wonders that were for me the discovery of a different world. Then he would look at his watch and say 'It is feeding time' and would go up to the mosquito net and casually put his fore-arm in for the mosquitoes to bite. It was startling for me, but for him it was just a matter-of-fact routine to offer his blood to mosquitoes. He would also urge me to look out for mosquito larvae in pools and water bodies wherever I went and wanted me to collect them for him. Such was his engagement to research and a desire to make useful contributions to medicine and society, which remained with him till his last days."

Dr. Iyengar travelled to many countries in the world, including Ceylon (now Sri Lanka), Maldives Islands, Thailand, Afghanistan, particularly several territories within the South Pacific Region, principally New Caledonia, West New Guinea, Cook Islands, Tahiti, Papua and East New Guinea, Western Samoa, Eastern Samoa, Niue and Fiji. He considered his far-off postings a challenge rather than relegation, and felt invigorated rather than sapped. He enjoyed every bit of his life in those remote and less accessible areas because he considered them a goldmine of opportunities for his research work (see Maps).

Dr. M.O.T. Iyengar passed away on 16 September 1972 and in his demise the world lost a great scientist. His wife, Mrs. Rukmani Iyengar, instituted through the Indian Council of Medical Research, the Dr. M.O.T. Iyengar Memorial Award which has been given annually to scientists who have made outstanding contributions in the fields of malaria, filariasis, plague or medical entomology.



Dr. M.O.T. Iyengar



Dr. Iyengar with Dr. Nespor in New Guinea



(L to R) Mr. M.A.U. Menon, Dr. Iyengar and
Mrs. Iyengar in New Caledonia

As one may note, Dr. M.O.T. Iyengar's research papers have been published in different research periodicals, some of which may not be easily accessible to a research worker. The main purpose of this publication is to collate all his papers, provide summaries of the more important ones and to present them in a consolidated form. It is felt that presentation of these papers in a chronological order would be of greater benefit than as different subjects of medical entomology. The summaries of selected papers have been prepared from a study of the original publications or from photostat copies. It is not always possible to abstract, in a limited space, all the data, information and views presented in a research publication. Nevertheless, such of the points that seemed to be of importance have been included employing frequently the exact words used by Dr. Iyengar. No change has been made to conform to the present-day nomenclature of the generic, sub-generic or specific names of mosquitoes or filariae. It is felt that, by this, the originality of Dr. M.O.T. Iyengar's papers will be maintained. Readers may, however, look up to the latest trend in the subject to update the nomenclature for their comprehension. To get a better understanding of Dr. Iyengar's work in the South Pacific Region, a map of the area is attached (Map 1). All the papers marked with an asterisk (*) are deposited, either as reprints or photostat copies, in the library of the Centre for Research in Medical Entomology, Madurai, India.

Dr. M.O.T. Iyengar was a tutor, mentor and inspiration to many entomologists, parasitologists and epidemiologists, and his work on malaria and filariasis will always remain as a monument. It is felt that this publication would have served its purpose if it inspires students, teachers and research workers to follow in his footsteps and excel in their vocation.

PUBLICATIONS OF DR. M.O.T. IYENGAR

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56. Studies on the epidemiology of filariasis in Travancore. Indian Med. Res. Mem., Memoir No. 30, 179 pages, 1938.
57. Differentiation of microfilariae of *Wuchereria bancrofti* and *Filaria malayi*. Indian J. Med. Res., **27**, 563-571, 1939.
58. Filariasis in India. Acta Conv. Tert. Trop. Act. Malar. Morb., Amsterdam, Part 1, 249-257, 1939.
59. A year's work on dissection of *Anopheles* for natural malarial infections. J. Malar. Inst. India, **2**, 105-109, 1939.

60. Further observations on the vectors of malaria in Bengal and notes on the seasonal infectivity of *Anopheles*. J. Malar. Inst. India, **30**, 115-123, 1940.
61. Occurrence of *Wuchereria bancrofti* infection in a rural area in Bengal. Indian J. Med. Res., **29**, 677-679, 1941.
62. Studies on malaria in the deltaic region of Bengal. J. Malar. Inst. India, **4**, 435-446, 1942.
63. Problems relating to malaria control in deltaic Bengal. J. Malar. Inst. India, **5**, 435-447, 1944.
64. Naturalistic control of the breeding of *Anopheles sundanicus* by means of *Eichornia* cover. J. Malar. Inst. India, **6**, 309-310, 1946.
65. Incidence of malaria in a deltaic area of lower Bengal between the Damodar and the Hooghly rivers. Indian J. Malar., **1**, 441-467, 1947. (In collaboration with M. Jafar).
66. Notes on *Harpagomyia genurostris* Leicester (Dipt: Culicidae). Proc. R. Ent. Soc. London, **23**, 39-43, 1948. (In collaboration with M.A.U. Menon).
67. Filariasis in the Maldiv Islands. Bull. World Hlth. Org., **7**, 375-403, 1952.
68. Malaria in the Maldiv Islands. Indian J. Malar., **7**, 1-3, 1953. (In collaboration with M.I. Mathew and M.A.U. Menon).
69. Filariasis in Thailand. Bull. World Hlth. Org., **9**, 731-766, 1953.
70. Preliminary report on an investigation on filariasis in New Caledonia. Sth. Pacif. Comm. Tech. Info. Circ., 11 pages, 1954.
71. Vector of malaria in Kabul, Afghanistan. Trans. Roy. Soc. Trop. Med. Hyg., **48**, 319-324, 1954.
72. Annotated bibliography of filariasis and elephantiasis. Part 1. Epidemiology of filariasis in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 65, 63 pages, 1954.
73. Filariasis in New Caledonia. Report of an investigation in Nassirah village. Sth. Pacif. Comm. Tech. Info. Circ., 5 pages, 1954.
74. Distribution of filariasis in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 66, 52 pages, 1954.
75. A scheme for filariasis control in Western Samoa. Sth. Pacif. Comm. Info. Circ., No. 2, 15 pages, 1954.
76. Mosquitoes of the Maldiv Islands. Bull. Ent. Res., **46**, 1-10, 1955. (In collaboration with M.A.U. Menon).
77. Distribution of mosquitoes in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 86, 47 pages, 1955.
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79. Studies on filariasis in New Caledonia. Sth. Pacif. Comm. Tech. Info. Circ., No. 15, 10 pages, 1956. (In collaboration with M.A.U. Menon).
80. The mosquitoes of South Thailand. Bull. Ent. Res., 77, 785-795, 1956. (In collaboration with M.A.U. Menon).
81. A report on an investigation on filariasis in the Cook Islands. Sth. Pacif. Comm. Tech. Info. Circ., No. 21, 15 pages, 1957.
82. Developmental stages of filariae in mosquitoes. Sth. Pacif. Comm. Tech. Pap., No. 104, 11 pages, 1957.
83. Annotated bibliography of filariasis and elephantiasis. Part 3. Symptomatology, aetiology, pathology and diagnosis of filariasis due to *Wuchereria bancrofti* and *W. malayi*. Sth. Pacif. Comm. Tech. Pap., No. 109, 276 pages, 1957.
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85. An investigation on filariasis in Niue. Sth. Pacif. Comm. Tech. Info. Circ., No. 30, 10 pages, 1958.
86. Annotated bibliography of filariasis and elephantiasis. Part 3. Symptomatology, aetiology, pathology and diagnosis of filariasis due to *Wuchereria bancrofti* and *W. malayi*. Supplement No. 1. Sth. Pacif. Comm. Tech. Pap., No. 109, 25 pages, 1959.
87. Annotated bibliography of filariasis and elephantiasis. Part 4. Treatment. Sth. Pacif. Comm. Tech. Pap., No. 124, 177 pages, 1959.
88. Filariasis in Netherlands New Guinea. Sth. Pacif. Comm. Tech. Info. Circ., No. 34, 8 pages, 1959.
89. Combating filariasis in Polynesia. Sth. Pacif. Comm. Quarterly Bull., 51-55, April 1959.
90. Filariasis in American Samoa. Sth. Pacif. Comm. Tech. Info. Circ., No. 35, 11 pages, 1959.
91. Interruption of transmission by *Anopheles*-borne filariasis by indoor residual spraying in Netherlands New Guinea. Trop. Geogr. Med., 11, 287-290, 1959. (In collaboration with H. de Rook and W.J.O.K. van Dijk).
92. A brief review of the epidemiology of filariasis in the South Pacific. Proc. 6th Int. Cong. Trop. Med. & Mal., Lisbon, 2, 339-343, 1959.
93. A review of the literature on the distribution and epidemiology of filariasis in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 126, 172 pages, 1959.
94. Annotated bibliography of filariasis and elephantiasis. Part 5. Prophylaxis and control of filariasis due to *Wuchereria bancrofti* and *W. malayi*. Sth. Pacif. Comm. Tech. Pap., No. 129, 102 pages, 1960.

95. A review of the mosquito fauna of the South Pacific (Diptera : Culicidae). Sth. Pacif. Comm. Tech. Pap., No. 130, 103 pages, 1960.
 96. Summary data on filariasis in the South Pacific. Sth. Pacif. Comm. Tech. Pap., No. 132, 92 pages, 1960.
 97. Validation of two species of *Coelomomyces* described from India. J. Eli. Mitch. Sci. Soc., **78**, 133-134, 1962.
 98. *Bironella gracilis* Theobald, 1905 (Insecta : Diptera). Proposed validation under the plenary powers, Z.N.(S) 1244. Bull. Zool. Nomen., **20**, 206-209, 1963. (In collaboration with E.N. Marks, i.M. Mackerras and D.J. Lee).
 99. Epidemiology of filariasis in the South Pacific. Sth. Pacif. Comm. Tech. Pap., No. 148, 183 pages, 1965.
 100. Infection experiments with a fungus (*Coelomomyces*) which kills malarial mosquitoes. Science, **158**, 526, 1967. (In collaboration with J.N. Couch and C.J. Umphlett).
 101. Eggs of two species of *Tripteroides* Giles from New Caledonia (Diptera : Culicidae). J. Aust. Ent. Soc., **8**, 214-216, 1969.
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SUMMARIES OF SELECTED RESEARCH PUBLICATIONS OF DR. M.O.T. IYENGAR

(PAPERS MARKED WITH AN ASTERISK ARE AVAILABLE AT THE CENTRE FOR RESEARCH IN
MEDICAL ENTOMOLOGY, MADURAI, INDIA)

- *1. On the Indian anophelines of the *funestus* group and the description of a new species. Indian J. Med. Res., 12, 23-30, 1924.

A new species of anopheline, *A. varuna*, is described and the main differences between *minimus*, *varuna* and *listoni* are summarized. The new species is intermediate in form between *A. minimus* and *A. listoni*. The main differences are with regard to the bands of the female palpi, the basal costal black spot and the 5th vein. It breeds in stagnant fresh water in ponds and ditches. It is most prevalent during and soon after the monsoons when it breeds in the collections of storm water by the road side often in company with *A. punctulatus* var. *tesselatus* and *A. barbirostris*.

- *2. Structure and function of the contractile thoracic appendages of the anopheles larva. Indian J. Med. Res., 16, 281-296, 1928.

These structures which appear on the dorsal side of the thorax help to hold the larva to the surface of the water. Regarding their origin it appears that these appendages are not prothoracic but mesothoracic. That they are not connected in any way with the developing prothoracic trumpets of the prospective pupa has been shown by serial sections.

- *3. Parasitic nematodes of *Anopheles* in Bengal. Trans. 7th Cong. F.E.A.T.M., 3, 128-135, 1929.

Worms of the genus *Mermis*, family Mermithidae, have been shown to parasitise anopheline larvae. The specific determination of this nematode has not been made. Its life-history and mode of infection of the larva has been studied and presented.

4. Microsporidian parasites of *Anopheles* larva. Trans. 7th Cong. F.E.A.T.M., 3, 135-142, 1929.

Anopheles larvae in lower Bengal are subject to parasitisation by Microsporidian of the genus *Thelohania*. The life cycle of *Thelohania* is described in detail. It was found that spores of *Thelohania* from different host species of *Anopheles* larvae vary markedly in regard to size. Infection of a larva occurs in two foci, one in the thorax and the other in the 8th and 9th segments of the abdomen.

- *5. Adult and larval stages of *Anopheles majidi*. Indian J. Med. Res., 17, 1-10, 1929.

Adult and larval stages of *Anopheles majidi* are described in detail. Close to *A. maculates*, *A. karwari* and *A. willmori*, *A. majidi* can be distinguished in the palpi, wings, femora, hind tibiae and absence of scales in the apical segments of the abdomen in the female (some scales are present in the male). A detailed description of the larva is also given.

- *6. Seasonal variations of the spleen rate. Indian J. Med. Res., 17, 11-32, 1929. (In collaboration with P. Sur).

A classification based on results of a single spleen census would give a very erroneous idea of the actual conditions of endemicity. An area identified as "highly endemic" in the monsoon would be classified as "moderately endemic" in November/December, and "healthy" in February.

- *7. Larvae of oriental tree-hole breeding anophelines. Indian J. Med. Res., 17, 769-778, 1930.

The characteristics of *Anopheles culiciformis*, *A. bariensis*, *A. asiaticus*, *A. anandalei* and *A. anandalei* var. *djajasanensis* are described. The range of geographic distribution of these species is given. A synoptic table to differentiate the larvae of tree-hole breeding species is given.

- *8. Dissolved oxygen in relation to *Anopheles* breeding. Indian J. Med. Res., 17, 1171-1188, 1930.

Investigations were carried out to ascertain if the distribution and numerical prevalence of six species of *Anopheles* were, in any way, related to the amount of the dissolved oxygen in the water. It was found that, in spite of the enormous diurnal variation of the dissolved oxygen, there was no "oxygen tolerance limits".

- *9. The larvae of *Anopheles turkhudi*. Indian J. Med. Res., 17, 1189-1192, 1930.

The most characteristic feature is the shape of the mouth brushes which project out on either side of head. Another feature is the primitive condition of the frontal hairs which are sparsely branched. The clypeal hairs are unbranched. The resting attitude of the larva differs from other *Anopheles* in that it rests at an angle to the water surface. A detailed description of the larva is given.

- *10. Jungle in relation to malaria in Bengal. Indian J. Med. Res., 18, 259-266, 1930.

Studies showed that species of *Anopheles* which occur inside jungle are harmless to man. Studies also showed that anophelines breeding in jungles are different from those found outside

the jungle in the cleared area. The factors are (1) probably the absence of sunlight and the consequent changes brought about in the fauna and flora of the breeding area, and (2) the lack of human and animal hosts for the adult mosquito. It is felt that any extensive deforestation without taking adequate safe-guards may be favourable for the breeding of carrier anophelines.

- *11. Absence of malaria in the salt-water Lake basin. Indian J. Med. Res., 19, 162-174, 1931.

While *Anopheles ludlowii* occurs in many areas of lower Bengal, it is difficult to explain its absence in the salt-water Lake.

- *12. The distribution of *Anopheles ludlowii* in Bengal and its importance in malarial epidemiology.

Indian J. Med. Res., 19, 499-524, 1931. It was shown that *Anopheles ludlowii* is the only species which shows positive correlation with water salinity. The presence of this brackish-water breeder and its role in malaria are discussed. Results also showed that a combination of the salinity factor with the presence of a small amount of organic contamination in the water were the optimum conditions for the breeding of *Anopheles ludlowii*.

- *13. The relative value of the oocyst rate and the sporozoite rate. Indian J. Med. Res., 19, 525-539, 1931.

The incidence of oocyst infections are higher in dissections in which the interval between the day of collection and the day of dissection is shortest and as the interval becomes longer, the incidence of oocyst infections decreases rapidly. On the other hand, the incidence of sporozoite infection is low in dissections carried out during the first few days after collection and it increases rapidly with the delay in the date of dissection. Thus the relative incidence of sporozoite and oocyst infections in any carrier species depends largely on the day of dissection.

- *14. *Anopheles* breeding in relation to season. Indian J. Med. Res., 19, 917-939, 1932.

Seasonal variations and prevalence in eleven species of *Anopheles* in rural Bengal are discussed. Of these, four species are likely to be actual carriers. They are *Anopheles aconitus*, *A. varuna*, *A. philippinensis* and *A. tessellatus*. An analysis of studies made showed that the breeding intensity of the local species of *Anopheles* varies considerably at different seasons of the year and that the different species exhibit a definite seasonal periodicity in breeding. *A. aconitus* and *A. varuna* have an intense breeding season during August to November and their lowest incidence is during May and June. *A. tessellatus* is a rare species in the area and has its peak between July and September, whereas the highest incidence of *A. philippinensis* occurs only in September.

15. The escape of the *Filaria* larva from the proboscis of *Culex fatigans*. Indian J. Med. Res., **19**, 941-942, 1932. (In collaboration with S. Sundar Rao).

The *Filaria* larva emerges from the extreme tip of the labella and not through the point of junction of the labium with the labellae.

16. On a *Characium* growing on *Anopheles* larvae. New Phytologist, **31**, 66-69, 1932. (In collaboration with M.O.P. Iyengar).

This is the first record of an alga, *Characium*, growing on an *Anopheles* larva. A new species, *C. anophelsi*, is described.

- *17. Experimental infection of some Indian mosquitoes with *Wuchereria (Filaria) bancrofti*. Indian J. Med. Res., **20**, 25-34, 1932. (In collaboration with S. Sundar Rao).

Out of 10 *Anopheles* species and 5 culicines infected experimentally, 5 anopheline species and one culicine were found to be efficient intermediate hosts. They were *Anopheles philippinensis*, *A. pallidus*, *A. fuliginosus*, *A. stephensi*, *A. ludlowii* var. *sundaica* and *Culex fatigans*.

- *18. Seasonal incidence of tertian, subtertian and quartan infections. Indian J. Med. Res., **20**, 303-326, 1932.

The incidence of *Plasmodium vivax* is highest during the months of March and April reaching a level of 67%, while *P. falciparum* reaches its highest level in September and October when it is above 70%. *P. malariae* infections are less common with a maximum of 33% in June.

- *19. Experimental infection of anopheline mosquitoes. Indian J. Med. Res., **20**, 841-861, 1933. Infection experiments were carried out with several species of *Anopheles* by feeding laboratory-bred mosquitoes on gametocyte carriers. Seven species were found susceptible to experimental infection with *Plasmodium falciparum*, namely, *A. aconitus*, *A. fuliginosus*, *A. jamesi*, *A. ludlowii* var. *sundaica*, *A. minimus*, *A. stephensi* and *A. varuna*. Six species of *Anopheles* were observed to be susceptible to infection with *P. vivax*, namely, *A. aconitus*, *A. fuliginosus*, *A. hyrcanus*, *A. minimus*, *A. stephensi* and *A. varuna*. Four species were found to be susceptible to infection with *P. malariae*, namely, *A. culicifacies*, *A. ludlowi*, *A. stephensi* and *A. varuna*.

20. Oviposition in mosquitoes of the genus *Mansonioides*. Indian J. Med. Res., **21**, 101-102, 1933.

Eggs are actually laid under water; the ovipositing female sits near the edge of a leaf touching the water surface and dips her abdomen into the water; by flexion, the tip of the abdomen is

applied to the lower side of the leaf. The eggs which are then extruded one by one are fixed on to the leaf surface and to the other eggs already laid, resulting in a compact circular cluster.

21. The identification of the common rat-fleas of India. Indian J. Med. Res., **22**, 675-686, 1935

A key for the identification of *Echidnophaga*, *Pulex*, *Xenopsylla*, *Leptopsylla*, *Ctenocephalides*, *Ceratophyllus* (*Nosopsyllus*) and *Stivalius* is provided.

- *22. Two new fungi of the genus *Coelomomyces* parasitic in larvae of *Anopheles*. Parasitology, Cambridge, **27**, 440-449, 1935.

Two new species, *Coelomomyces indiana* and *C. anophelsica*, are described and morphological differentiation with the other known species, namely, *C. stegomyiae* and *C. notonectiae* are given. These four species fall into two well-defined groups, the first group comprising *C. stegomyiae* and *C. notonectae*, and the other of *C. indiana* and *C. anophelsica*. The species comprising the second group have a non-anastomosing mycelium which is very fragile, broad and with a thin wall. In species of the first group, the mycelium branches considerably and anastomoses, narrow and with a thick wall. The development of these two new species in the larva is shown.

23. Biology of Indian mosquito larvae that attach themselves to roots of water plants. Proc. R. Ent. Soc. London, **10**, 9-11, 1935.

The manner in which larvae and pupae of *Mansonia annulifera*, *M. uniformis* *M. indiana* and *Ficalbia hybrida* obtain oxygen from roots of aquatic plants is described. In India these larvae utilise only *Pistia stratiotes*. Presence of this plant is essential for the life of the larvae, as also for the oviposition of *Mansonia*. A certain amount of organic contamination is also necessary in the breeding places.

24. Eggs of *Ficalbia minima* Theo., and notes on the breeding habits of three species of *Ficalbia*. Bull. Ent. Res., **26**, 423-425, 1935.

The eggs of *Ficalbia minima* are described and compared with those of *Mansonioides annulifera*.

- *25. Entry of *Filaria* larvae into the body cavity of the mosquito. Parasitology, Cambridge, **28**, 190-194, 1936.

Examination of serial sections of bred mosquitoes on carriers with microfilariae showed that the microfilaria penetrates through the wall of the gut near the proventriculus or in the proventriculus itself, and escapes into the perivisceral cavity of the thorax.

26. Eggs of *Anopheles leucosphyrus*. J. Malar. Inst. India, 1, 353-354, 1938.

Eggs of *Anopheles leucosphyrus* has been described for the first time. It resembles closely to eggs of *A. tessellatus* and that of *A. kochi* and characters that differentiate the latter two from *A. leucosphyrus* are given.

27. Natural parasites of mosquitoes in India. Proc. Nat. Inst. Sci. India, 4, 237-239, 1938.

Coelomomyces, *Microsporidia* and *Memithidae* are the important parasites of mosquito larvae. Details are given of these three genera and their role in the natural control of malaria.

- *28. Studies on the epidemiology of filariasis in Travancore. Indian J. Med. Res. Memoirs, Memoir No. 30, 179 pages, 1938.

Two species of filarial infection, namely, *Wuchereria bancrofti* and *Filaria malayi* occur in Travancore State (now known as Kerala). The endemic areas may be grouped under four classes according to the incidence of the type of infection (1) areas with only *F. malayi* infection, (2) areas with both infections, *F. malayi* being the predominant one, (3) areas with both infections, *W. bancrofti* being the predominant type, and (4) areas with only *W. bancrofti* infection. (Fig.1). *F. malayi* infection occurs extensively in the sandy tract in the north-west rural areas, whereas, *W. bancrofti* is typically urban in distribution. The endemicity and incidence of infection in the different age groups are discussed in detail. During this investigation, 76 species of mosquitoes were recorded of which 15 species were found infected with filarial larva in nature. It was established that in *W. bancrofti* areas, *Culex fatigans* was the only important transmitter, while, in *F. malayi* areas the primary vectors were *Mansonioides annulifera* and *M. uniformis*, the former being the more important. Factors that determine the endemicity of the two filarial infections and methods for their control are given. This is a comprehensive report on the epidemiology of filariasis in Travancore and must be studied in the original.

- *29. Differentiation of microfilariae of *Wuchereria bancrofti* and *Filaria malayi*. Indian J. Med. Res., 27, 563-571, 1939.

Important points in the differentiation of the microfilariae of these two species are given. These include differences in length, breadth, cephalic space, the G-cells, cells G-1 to G-4, the tail nuclei, etc. Some excellent diagrams are provided.

- *30. A year's work on dissection of *Anopheles* for natural infection. J. Malar. Inst. India, 2, 105-109, 1939.

Of 22 species of anophelines collected in endemic areas of Bengal, *Anopheles philippinensis*, *A. minimus* and *A. pallidus* were found naturally infected. The infection rates were 7.2%, 6.0% and 0.5% respectively. Findings indicated that *A. philippinensis* is the most important vector in the plains of Bengal and *A. minimus* in the foothill regions.

- *31. Further observations on the vectors of malaria in Bengal and notes on the seasonal infectivity of *Anopheles*. J. Malar. Inst. India, 3, 115-123, 1940.

Out of 16 species examined, *Anopheles philippinensis*, *A. minimus*, *A. varuna*, *A. annularis* and *A. sundaicus* were found naturally infected. Sporozoite rates in the three species, *A. philippinensis*, *A. minimus* and *A. sundaicus* were 3.9%, 9.3% and 5.3% respectively. *A. philippinensis* was observed infected from May to February with a high incidence between September and November. Findings also showed that the important vectors of malaria in Bengal are *A. philippinensis* in the plains, *A. minimus* in the submontane zone and *A. sundaicus* in the estuarine region.

- *32. Studies on malaria in the deltaic region of Bengal. J. Malar. Inst. India, 4, 435-446, 1942.

It was observed that in villages with a low subsoil water level, the density of *Anopheles philippinensis* and the incidence of malaria was high. In villages where the water table was close to the ground surface the incidence of this mosquito and the disease was very low. Therefore, a positive correlation exists between the density of *A. philippinensis* and the distance of the water table from the ground level.

- *33. Problems relating to malaria control in deltaic Bengal. J. Malar. Inst. India, 5, 435-447, 1944.

Anopheles philippinensis is the main vector in deltaic Bengal (excluding the estuarine zone). Infection rates are high from July to December. Its breeding season is from July to October. Breeds in ponds with clear sunlit water, free from organic contamination. Plants which grow over the water, such as the water hyacinth (*Eichornia speciosa*) and produce a shade over the water surface are inhibitory for the breeding of this species.

- *34. Naturalistic control of the breeding of *Anopheles sundaicus* by means of *Eichornia* cover. J. Malar. Inst. India, 6, 309-310, 1946.

In addition to the feasibility of employing the water hyacinth for the control of *Anopheles philippinensis*, it was found that this type of vegetation inhibits the breeding of *A. sundaicus*. It was also observed that the dense cover with *Eichornia* kills much of the vegetation favourable for the larvae of this species such as *Enteromorpha*, *Hydrilla*, *Naias*, etc.

- *35. The incidence of malaria in a deltaic area of lower Bengal between the Damodar and the Hooghly rivers. Indian J. Malar., **1**, 441-467, 1947. (in collaboration with M. Jafar).

Villages situated on comparatively elevated land in the Hooghly-Damodar Flood-flush Scheme are highly malarious and those in the low-lying areas are, as a rule, free from malaria. The degree of malaria incidence in this area is related to the depth of the water table in the rainy season. A high water table brought about by lack of natural drainage or by rise in the flood level of the adjoining river or by the influx of irrigation water tends to lower the incidence of malaria. Safeguards are detailed to reduce the breeding of *Anopheles philippinensis*, the local vector in the area.

- *36. Notes on *Harpogomyia genurostris* Leicester (Dipt. Culicidae). Proc. R. Ent. Soc. London, **23**, 39-43, 1948. (In collaboration with M.A.U. Menon).

The most common and prolific breeding places of *Harpogomyia genurostris* are water collections in the leaf bases of *Alocasia indica*. The breeding season is during the rains. The unique resting position of the larva and pupa, and the ensuing morphological modifications are described in detail. The adult, when resting, has a peculiar side-to-side rhythmic movement. It is of interest to note that the proboscis of the adult is bent under the body, very much as in Hemiptera.

- *37. Filariasis in the Maldives Islands. Bull. World Hlth. Org., **7**, 375-403, 1952.

A general description of the Maldives Archipelago is given. Filariasis due to periodic *Wuchereria bancrofti* is highly endemic, filarial endemicity rates varying between 21% and 41%. Filarial infection rates were observed in children aged from four to five years and elephantiasis of the leg in children aged eight to ten years. Infection is primarily transmitted by *Culex fatigans* and secondarily by *Anopheles tessellatus*. Breeding of *C. fatigans* occurs mainly in step-wells with contaminated water. Vector control measures are suggested. To obtain a comprehensive report on filariasis in the Maldives Islands, the original paper must be consulted.

- *38. Malaria in the Maldives Islands. Indian J. Malar., **7**, 1-3, 1953. (In collaboration with M.I. Mathew and M.A.U. Menon).

Malaria is highly endemic in the villages of the southern atolls. Spleen rates varied between 40% and 60%. The parasite rate in children in one village was 45.1%. The main infection was with *Plasmodium malariae*. *Anopheles tessellatus* was found to be the vector and was found breeding extensively in wells and, to a lesser extent, in step-wells.

- *39. Filariasis in Thailand. Bull. World Hlth. Org., 9, 731-766, 1953. Endemic filariasis in Thailand is restricted to the flat, low-lying rural areas of the

eastern coastal belt. The causative organism is *Wuchereria malayi*. Four species of *Mansonia*, namely, *M. annulifera*, *M. uniformis*, *M. indiana* and *M. longipalpis*, and five species of *Anopheles*, namely, *A. barbirostris*, *A. hyrcanus nigerrimus*, *A. (H) sinensis*, *A. albotaeniatus* and *A. umbrosus* were found to be vectors. Spraying dwellings with residual insecticides would be feasible and economical.

- *40. Vector of malaria in Kabul, Afghanistan. Trans. Roy. Soc. Trop. Med., 48, 319-324, 1954.

Of the seven species of anopheline mosquitoes recorded, *Anopheles superpictus* was found to be the vector. The season of active transmission was from July to September.

- *41. Annotated bibliography of filariasis and elephantiasis. Part 1. Epidemiology of filariasis in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No.65, 63 pages, 1954.

The first of a series of publications on the bibliography of filariasis and elephantiasis in the South Pacific Region. Summaries of 116 articles by 104 authors are given. Must be consulted in the original.

- * 42. Distribution of filariasis in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 66, 52 pages, 1954.

Detailed information is furnished, supported by references, on (a) the distribution and incidence of endemic microfilarial infection in different parts of the South Pacific.

(Map 2), (b) distribution and incidence of elephantiasis, (c) distribution of the periodic and non-periodic forms of *Wuchereria bancrofti* and (d) vectors of filarial infection and the recorded infection rates (both natural and experimental) in them. The relatively low incidence of elephantiasis in the western part and its high incidence in the eastern part of the South Pacific Region are not attributable to any difference in the pathogenicity of the two forms of *W. bancrofti*, but to differences in local conditions as regards opportunities for the establishment of hyperfiliation in the human host. The line of demarcation dividing the distribution of the two forms of *W. bancrofti* are shown. This line runs between Gilbert Islands and New Hebrides on one side and the Ellice Islands, Fiji and Loyalty islands (Map 3). The two forms are morphologically indistinguishable.

The primary vectors are species of the *Aedes scutellaris* group in the eastern section, *Culex fatigans* in the north, *Anopheles farauti* in the coastal areas of the western part, namely, New

Guinea (including the Bismark Archipelago), Solomons and New Hebrides, and *Aedes vigilax* in New Caledonia (Map 4). It will be interesting to note that no anopheline species or any species of the *Aedes scutellaris* group is present in New Caledonia. This paper must be studied in the original.

- *43. A scheme for filariasis control in Western Samoa. Sth. Pacif. Comm. Tech. Info. Circ., No. 20, 15 pages, 1954.

The primary vector (and perhaps the only vector) of filarial infection is *Aedes (Stegomyia) polynesiensis* with natural infection rates varying between 10% and 25%. Two peaks of activity were noticed, a greater one in the afternoon and a lesser one early in the morning. They were found to be more abundant in well-shaded areas than in clearings. No evidence of seasonal variation was found. Resting mosquitoes were not found in houses or other man-made shelters but in low vegetation and in crevices in stone walls. This species breeds in small containers like cut cocoa-pods, coconut shells and discarded tins. Filarial infections are caused by *Wuchereria bancrofti* var. *pacifica*.

Various control measures have been suggested which include, apart from manual removal of breeding sites, health education and suitable legislation.

- *44. Mosquitoes of the Maldive Islands. Bull. Ent. Res., 46, 1-10, 1955. (In collaboration with M.A.U. Menon).

A large collection of mosquitoes made in five atolls of the Maldive Islands revealed the presence of 15 species. These are listed and notes of taxonomic interest on seven of them are given. Research workers interested in systematics should consult the original.

- *45. Annotated bibliography of filariasis and elephantiasis. Part 2. Studies on the mosquitoes of the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 88, 114 pages, 1956.

Second publication in the series deals with literature on mosquitoes of the South Pacific Region, primarily, studies on their morphology, nomenclature, taxonomy, genetics, bionomics and distribution. 426 research papers by 90 authors are reviewed. This publication must be consulted in the original.

- *46. Studies on filariasis in New Caledonia. Sth. Pacif. Comm. Info. Circ., No. 15, 10 pages, 1956. (In collaboration with M.A.U. Menon).

Aedes vigilax was found to be naturally infected in the endemic areas of New Caledonia. The

causative organism was the non-periodic *Wuchereria bancrofti*. *Aedes notoscriptus* has, for the first time, been shown to be a favourable host under experimental conditions. High percentage of infection has also been recorded in *Culex fatigans* experimentally.

- *47. The mosquitoes of South Thailand. Bull. Ent. Res., **47**, 785-795, 1956. (In collaboration with M.A.U. Menon. With an appendix by P.F. Mattingly).

Taxonomic notes are given on eight species and a description of the larva of *Uranotaenia bimaculiala* Leic. previously undescribed is included. The characters by which *U. bimaculiala* can be separated from the closely allied *U. micans* Leic. And *U. edwardsi* Barraud are detailed. Taxonomic notes are also provided on the adults and larvae of *U. bimaculiala* and *U. longirostris*, on the female and egg of *Taeniorhynchus (Coquillettidia) giblini*, on the larva of *Aedomyia catastica*, and on the adult male or female or both of *Aedes (Aedes) dux*, *A. (A.) butleri*, *A. (A.) vallistris* and *Anopheles barbumbrosus*. The original paper must be studied for detailed descriptions of all eight species.

- *48. A report on an investigation of filariasis in the Cook Islands. Sth. Pacif. Comm. Tech. Info. Circ., No. 21, 14 pages, 1957.

The type of filarial infection occurring is the non-periodic form of *Wuchereria bancrofti*. Incidence of filarial infection varied between 17.7% and 28.2%, and incidence of the disease between 1.1% and 5.0%. The infection and disease rates were found to be higher in females than among males. Microfilaria rates showed a continuous rise from 2.5% (in the age group 1-4 years) to 46.5% (in the age group 50 years and above). *Aedes polynesiensis* is the vector, breeding mainly in cisterns used for collecting rain water and drums for storing water. Details of control measures are given.

- *49. Developmental stages of filariae in mosquitoes. Sth. Pacif. Comm. Tech. Pap., No. 104, 11 pages, 1957.

Detailed descriptions of the morphology of *Wuchereria bancrofti*, *W. malayi* and *Dirofilaria immitis* (a common parasite of the dog) are given. The characters by which the microfilariae of these three species can be differentiated, namely, (a) presence or absence of a sheath, (b) the length of the microfilaria, (c) the cephalic space, (d) position of excretory cell in relation to the excretory chamber, (e) character and position of anal pore, and (f) character of the tail end are given. The developmental stages of these three species in the mosquito are given. Mention is also made of other nematodes, artefacts and parasites which could be mistaken for filarial larvae. Excellent diagrams are provided. The original paper must be consulted.

- *50. Annotated bibliography of filariasis and elephantiasis. Part 3. Symptomatology, aetiology, pathology and diagnosis of filariasis due to *Wuchereria bancrofti* and *W. malayi*. Sth. Pacif. Comm. Tech. Pap., No. 109, 276 pages, 1957.

This is the third issue in the series of annotated bibliography on filariasis and elephantiasis. Summaries are provided of 870 publications by 532 authors. This comprehensive paper must be consulted in the original.

- *51. Annotated bibliography of filariasis and elephantiasis. Part 3. Supplement No. 1. Sth. Pacif. Comm. Tech. Pap., No. 109, Supplement No. 1, 25 pages, 1959. In this supplement to Part 3, further references are provided.

- *52. Annotated bibliography of filariasis and elephantiasis. Part 4. Treatment. Sth. Pacif. Comm. Tech. Pap., No. 124, 177 pages, 1959.

Deals with literature on the medical and surgical treatment of filariasis due to *Wuchereria bancrofti* and *W. malayi*. Summaries are provided of 490 publications by 203 authors. Some of the papers dealing with tests carried out on animal filariae, such as *Dirofilaria immitis* in dogs and *Litomosoides carinii*, in so far as they have a bearing on filariasis in man, are also included. A comprehensive document and must be consulted in the original.

- *53. An investigation of filariasis in Niue. Sth. Pacif. Comm. Tech. Info. Circ., No. 30, 10 pages, 1958.

Filariasis is endemic in Niue. Observations showed that the microfilariae is the non-periodic form of *Wuchereria bancrofti* which has a wide distribution in the Polynesian Islands of the South Pacific. Although definite evidence could not be found, it could be safely assumed, from epidemiological grounds, that the local form of *Aedes tongae* is the vector of filarial infection. Vector control measures are suggested.

- *54. Filariasis in the Cook Islands. Sth. Pacif. Comm. Quarterly Bull., January, 25-27, 1957. (In collaboration with M.A.U. Menon).

Investigations showed that the incidence of filariasis is high. One in every five was infected with the parasite and one in every twenty-five showed signs of filarial disease. The vector is *Aedes polynesiensis*, which bites during the day. One in every eight caught was found infected. Breeds in artificial containers of water, like drums, cisterns, discarded tins, etc. Moreover, rats eating the coconut crop, which fall to the ground and collect rain water, provide ideal breeding conditions.

- *55. Filariasis in the Netherlands New Guinea. Sth. Pacif. Comm. Tech. Info. Circ., No. 34 8 pages, 1959.

The causative organism is the nocturnal periodic form of *Wuchereria bancrofti*. The infection has a wide distribution and is restricted to the low-lying flat areas on the mainland and to the off-shore islands. Three species of the *Anopheles punctulatus* group, namely, *A. farauti*, *A. koliensis* and *A. punctulatus* are known to be vectors. Filarial infection is also transmitted by one or more of the three culicines, namely, *Mansonia uniformis*, *Culex bitaeniorhynchus* and *C. annulirostris*. *Anopheles bancrofti* and *Aedes kochi* have also been incriminated.

- *56. Filariasis in American Samoa. Sth. Pacif. Comm. Info. Circ., No. 35, 11 pages, 1959.

Vector of filarial infection is *Aedes polynesiensis* and the type of infection is the non-periodic form of *Wuchereria bancrofti*. Microfilarial infection rate varied between 14.9% and 20.3%. The disease rate varied between 1.0% and 10.5%. The main source of breeding of the vector are coconut shells, rat-eaten coconuts and discarded tins. Biology of *A. polynesiensis* is discussed. Measures are suggested for the control of filariasis in American Samoa.

- *57. Interruption of transmission of anopheline-borne filariasis by indoor residual spraying in Netherlands New Guinea. Trop. Geogr. Med., Amsterdam, 11, 287-290, 1959. (In collaboration with H. de Rook and W.J.O.M. van Dijk).

Evidence is furnished to show that the transmission of *Wuchereria bancrofti* infection by mosquitoes of the *Anopheles punctulatus* group has been effectively interrupted by residual spraying with DDT.

- *58. A review of the literature on the distribution and epidemiology of filariasis in the South Pacific Region. Sth. Pacif. Comm. Tech. Pap., No. 126, 172 pages, 1959.

All available information contained in published and unpublished reports and papers pertaining to the distribution and epidemiology of filariasis in the South Pacific Region has been presented. Includes 311 summaries of papers by 207 authors. This document must be consulted in the original.

- *59. Annotated bibliography of filariasis and elephantiasis. Part 5. Prophylaxis and control of filariasis due to *Wuchereria bancrofti* and *W. malayi*. Sth. Pacif. Comm. Tech. Pap., No. 129, 102 pages, 1960.

63. Infection experiments with a fungus (*Coelomomyces*) which kills malarial mosquitoes. *Science*, **158**, 526, 1967. (In collaboration with J.N. Couch and C.J. Umphlett).

Successful infection seems to depend on putting germinating sporangia and hatching eggs together for about 24 hours and then transferring the larvae to an environment favourable for the best development of the larvae.

64. Eggs of two species of *Tripteroides* Giles from New Caledonia (Diptera; Culicidae). *J. Aust. Ent. Soc.*, **8**, 214-216, 1969.

Eggs of *Tripteroides caledonicus* (Edwards) and *T. melanesiensis* Belkin are described and figured. Known eggs of nepanthicolous *Tripteroides* differ in shape from eggs of species colonizing artificial containers.

ABBREVIATIONS USED IN ABSTRACTED RESEARCH PUBLICATIONS

Acta Conv. Tert. Trop. Atq.	Acta Conventus Tertii de Tropis Atque
Mal. Morb. Amsterdam.	Malariae Morbis., Amsterdam.
Bull. Ent. Res.	Bulletin of Entomological Research, London.
Bull. World Hlth Org.	Bulletin of the World Health Organization.
Bull. Zool. Nomen.	Bulletin of Zoological Nomenclature.
Indian J. Malar.	Indian Journal of Malariology.
Indian J. Med. Res.	Indian Journal of Medical Research.
Indian. Med. Res. Mem.	Indian Medical Research Memoirs.
Indian Med. Gaz.	Indian Medical Gazette.
J. Aust. Ent. Soc.	Journal of the Australian Entomological Society.
J. Eli. Mitch. Sci. Soc.	Journal of the Elisa Mitchell Science Society.
J. Indian Bot. Soc.	Journal of the Indian Botanical Society.
J. Malar. Inst. India.	Journal of the Malaria Institute of India, New Delhi.
Proc. 6 th Cong. Trop. Med. & Mal., Lisbon.	Proceedings of the Sixth International Congress of Tropical Medicine and Malaria, Lisbon.
Proc. Nat. Inst. Sci., India.	Proceedings of the National Institute of Sciences, India.
Proc. R. Ent. Soc., London.	Proceedings of the Royal Entomological Society, London.
Rec. Mal. Surv. India.	Records of the Malaria Survey of India.
Rep. Proc. Fourth Entom. Meeting.	Report of the Proceedings of the Fourth Entomological Meeting, Pusa.
Rep. Proc. Fifth Entom. Meeting	Report of the Proceedings of the Fifth Entomological Meeting, Pusa.
Trans. 7 th Cong. F.E.A.T.M.	Transactions of the Seventh Congress of the Far Eastern Association of Tropical Medicine, Amsterdam.
Trans. Roy. Soc. Trop. Med. & Hyg., London	Transactions of the Royal Society of Tropical Medicine and Hygiene, London.
Trop. Geogr. Med.	Tropical and Geographical Medicine, Amsterdam.
Sth. Pacif. Comm. Tech. Info. Circ.	South Pacific Commission Technical Information Circular.
Sth. Pacif. Comm. Tech. Pap.	South Pacific Commission Technical Paper.
Sth. Pacif. Comm. Quarterly Bull.	South Pacific Commission Quarterly Bulletin.

ACKNOWLEDGEMENT

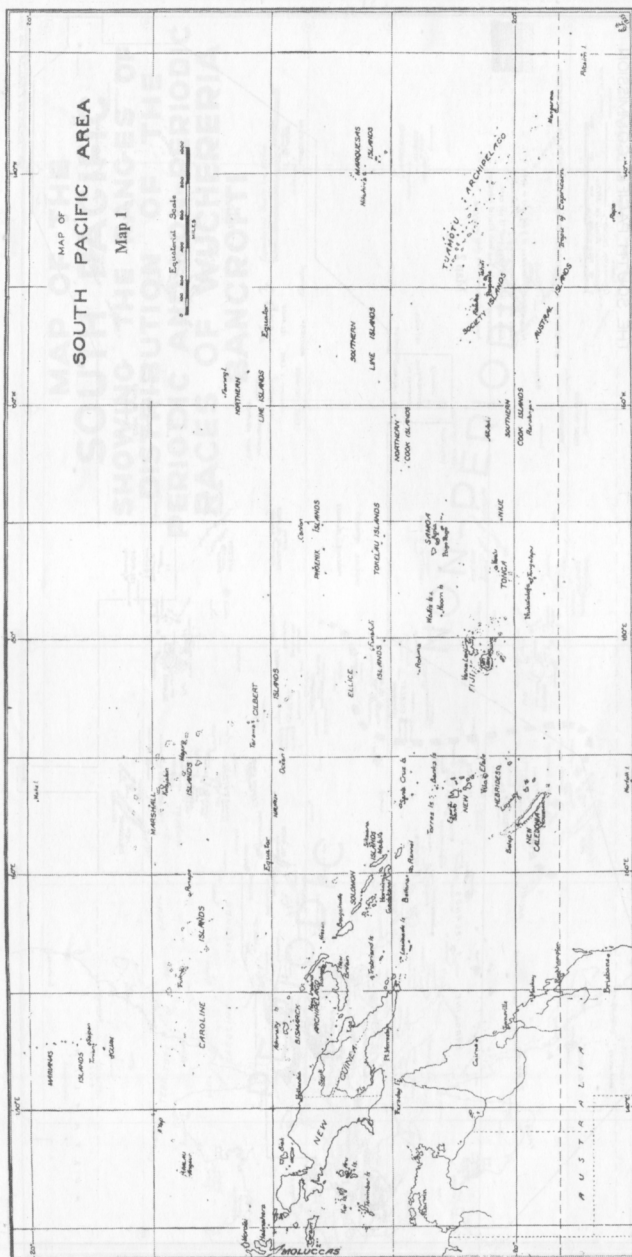
It is always difficult to write a biography of near and dear ones. Even more so if a son has to write about his father. However objective one may be, there will always be a nagging thought at the back of one's mind of being favourably biased. Nevertheless, ably aided by Ms. Tara Gandhi, I have endeavoured to give as true a picture as possible of Dr. M.O.T. Iyengar, to whose family we both belong.

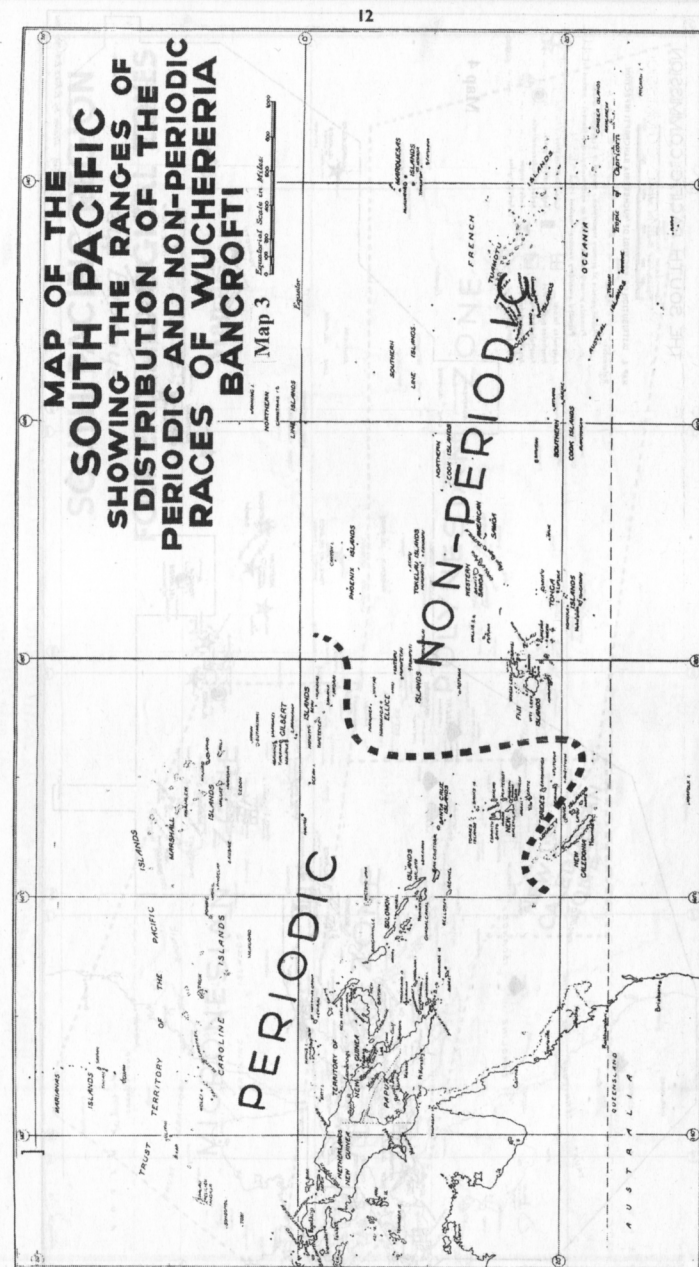
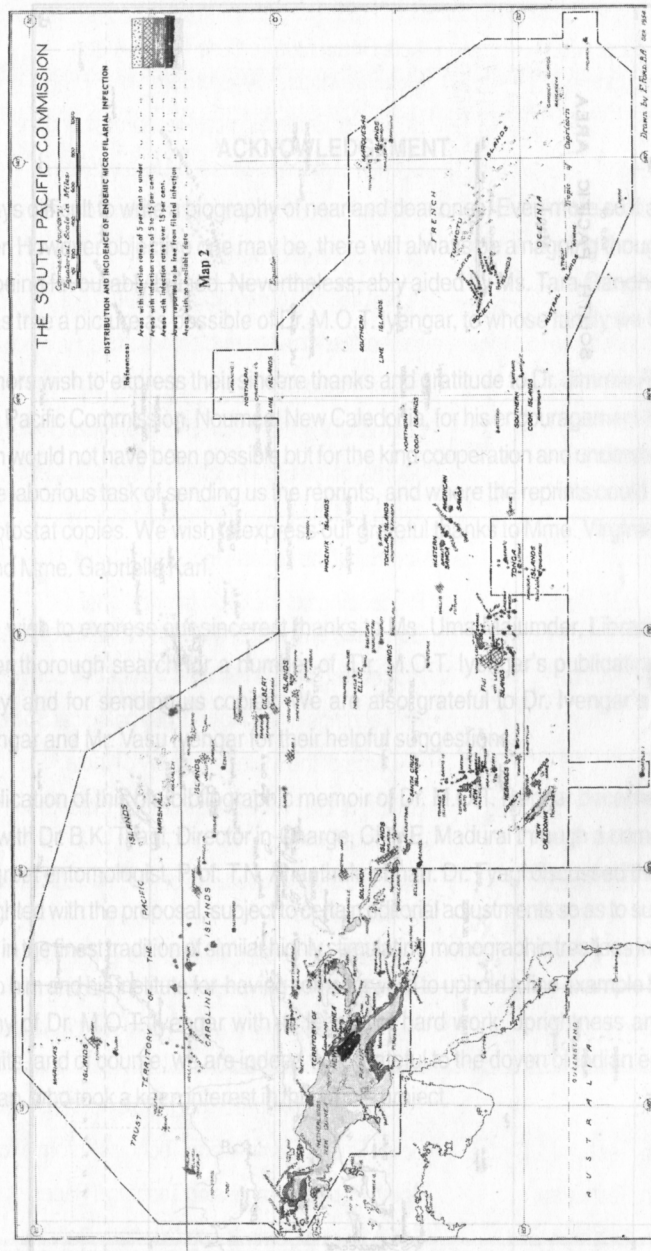
The authors wish to express their sincere thanks and gratitude to Dr. Jimmie Rodgers, Director General, South Pacific Commission, Noumea, New Caledonia, for his encouragement in this publication. This publication would not have been possible but for the kind cooperation and understanding of his staff who took on the laborious task of sending us the reprints, and where the reprints could not be spared, of sending us photostat copies. We wish to express our grateful thanks to Mme. Virginie Cadenat, Mme. Anne Gibert and Mme. Gabrielle Kari.

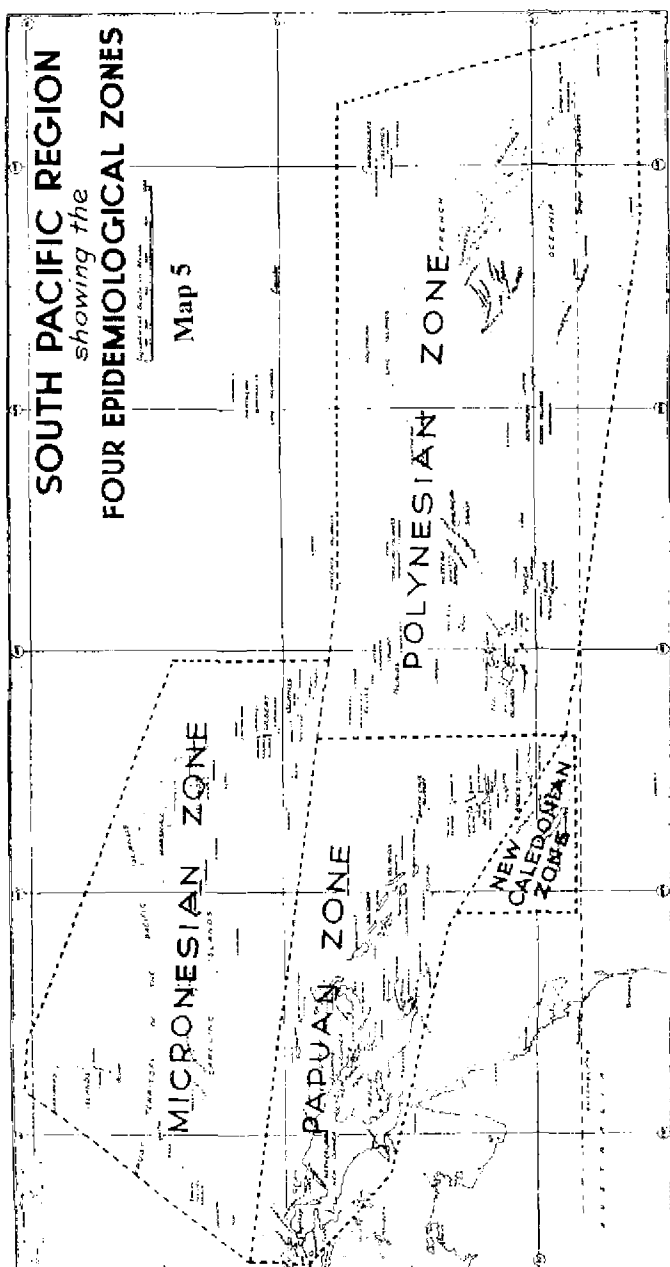
We also wish to express our sincerest thanks to Ms. Uma Majumder, Librarian, Raj Bhavan, Kolkata, for her thorough search for a number of Dr. M.O.T. Iyengar's publications that were not available easily, and for sending us copies. We are also grateful to Dr. Iyengar's two other sons, Dr. M.O.N. Iyengar and Mr. Vasu Iyengar for their helpful suggestions.

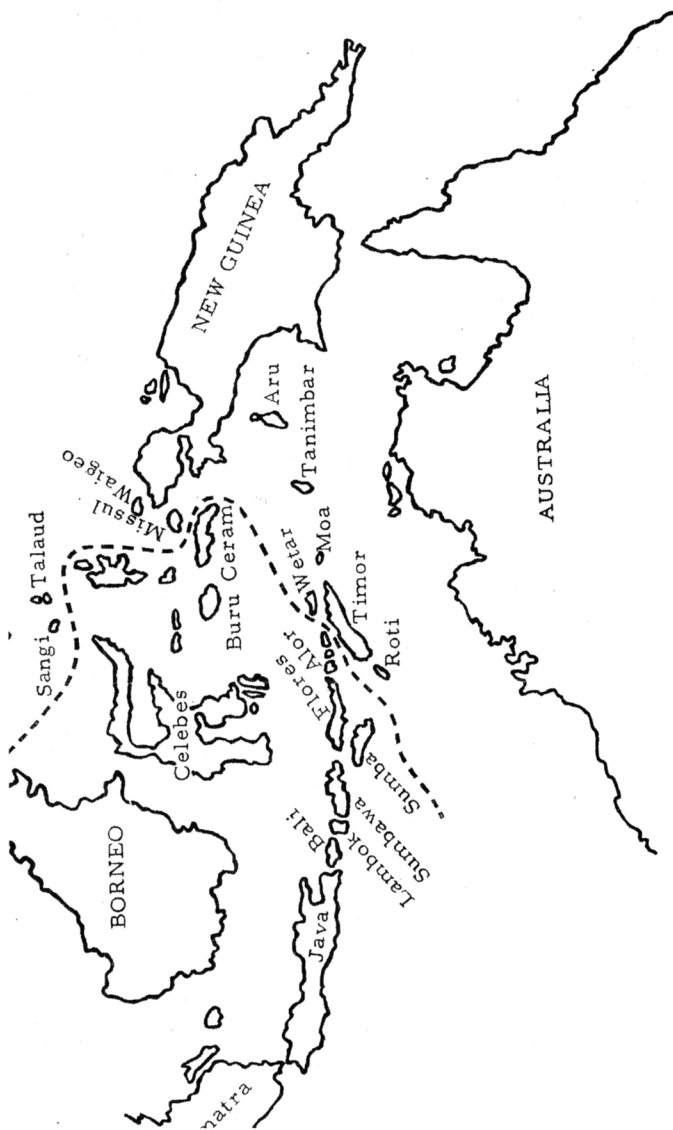
The publication of this bio-bibliographic memoir of Dr. M.O.T. Iyengar became possible once I came in touch with Dr. B.K. Tyagi, Director-in-Charge, CRME, Madurai through a common well wisher, and himself a great entomologist, Prof. T.N. Ananthkrishnan. Dr. Tyagi discussed the issue, and was apparently delighted with the proposal, subject to certain editorial adjustments so as to suit his Conference requirements – in the finest tradition of similar highly stimulating monographic treatises in the past. We are most thankful to him and his institute for having come forward to uphold a fine example by publishing this bio-bibliography of Dr. M.O.T. Iyengar with its legacy of hard work, uprightness and application to scientific pursuits, and of course, we are indeed very grateful to the doyen of Indian entomology, Prof. Ananthkrishnan, who took a keen interest in this whole project.

Dr. R. Iyengar









Map 6. Showing easterly limit of the range of distribution of endemic *Brugia malayi*

